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| 09/785,999      | 02/16/2001  | Jay E. Uglow         | LAMP1P106A          | 2171             |

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EXAMINER

PHAM, THANHHA S

| ART UNIT | PAPER NUMBER |
|----------|--------------|
|----------|--------------|

2813

DATE MAILED: 07/18/2002

9

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

09/785,999

Applicant(s)

UGLOW ET AL.

Examiner

Thanhha Pham

Art Unit

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 10 June 2002.
- 2a) ☒ This action is **FINAL**.                      2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-16 and 24-29 is/are pending in the application.
- 4a) Of the above claim(s) 25-29 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-16 and 24 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 8.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_.

### **DETAILED ACTION**

Regarding to Applicant's amendment paper #3 that cancels claims 17-25 (application is originally filled on 02/16/01) and adds claims 26-31. Since the originally-filed application includes only claims 1-23, claims 17-23 (instead of claims 17-25) are cancelled based on Applicant's amendment paper #3. Claims 26-31, being added in paper #3, are now renumbered as claims 24-29 respectively. Based on Applicant's election of claims 1-16 and 26 in paper #5, claims 1-16 and 24 (claim 26 being renumbered as claim 24) have been examined on merit. Claims 25-29, after being renumbered from claims 27-31 respectively, have been withdrawn from consideration.

Examiner respectively reminds Applicant to notice the changes of claims after being renumbered as above. Currently, claims 1-16 and 24-29 are pending. Claims 1-16 and 24 are being examined. Claims 25-29 are withdrawn from consideration due to restriction requirement.

### ***Election/Restrictions***

1. This application contains claims 25-29 are drawn to an invention nonelected with traverse in Paper No. 5. A complete reply to the final rejection must include cancelation of nonelected claims or other appropriate action (37 CFR 1.144) See MPEP § 821.01.

### ***Claim Rejections - 35 USC § 112***

The following is a quotation of the second paragraph of 35 U.S.C. 112:

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The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. Claims 1-16 and 24 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

With respect to claim 1,

Lines 7-8, "the inorganic dielectric layer being highly selective relative to the barrier when etched" renders the claim indefinite. It is not clear what will be etched when etched. In addition, "highly selective relative to" is a relative term which renders the claim indefinite; the term "highly selective relative to" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention. Moreover, "the inorganic dielectric layer being highly selective relative to the barrier when etched" is a "not- positively-cited" limitation that does not have patent weight since a step etching is not positively cited – What happened if a step of etching is not existed in the process for making a dielectric structure for a dual-damascene application? "the inorganic dielectric layer being highly selective relative to the barrier when etched" will not have patent weight unless a step of etching is positively cited in the claim.

Line 9, term "a low dielectric constant layer" is a relative term which renders the claim indefinite. The term "low dielectric constant" is not defined by the claim, the specification does not provide a standard for ascertaining the

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requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention. It is not clear how low of a dielectric constant for a dielectric layer is considered as a low dielectric constant layer.

With respect to claims 2, 6-7, 10, 13, 14,

term "a low dielectric constant layer" is a relative term which renders the claim indefinite. The term "low dielectric constant" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention. It is not clear how low of a dielectric constant for a dielectric layer is considered as a low dielectric constant layer.

### ***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in-

(1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effect under this subsection of a national application published under section 122(b) only if the international application designating the United States was published under Article 21(2)(a) of such treaty in the English language; or  
(2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that a patent shall not be deemed filed in the United States for the purposes of this subsection based on the filing of an international application filed under the treaty defined in section 351(a).

- ✓ 1. Claims 1-3, 7-8, 10, and 14, as being best understood, are rejected under 35 U.S.C. 102(e) as being anticipated by Jain [US 5,821,168]. .

**\*\*Notice:** *this rejection is based on the scope of using "a low dielectric constant layer" as a name of a dielectric layer to define a trench.*

Jain, figs 1-10 and col 1-6, discloses a method for making a multi-layer inter-metal dielectric over a substrate or a dielectric structure for dual-damascene application comprising steps of:

forming a barrier layer (48, a nitride layer, fig 3) on a substrate and metallization lines (28) within the substrate;

forming an inorganic dielectric silicon dioxide layer (26, silicon dioxide by TEOS or SiOF, fig 3) to define a via dielectric layer over the barrier layer;

forming a low dielectric constant layer (54, paralene, fig 3) to define a trench dielectric layer over the inorganic dielectric silicon dioxide layer; and

forming a trench through the low dielectric constant layer and a via in the trench extending through inorganic dielectric silicon dioxide layer to the barrier layer by an etch chemistry (see fig 4).

With respect to claim 2, those skilled in the art should recognize that a first etch chemistry must be used to form the trench in the low dielectric constant layer of paralene in the process of Jain.

With respect to claims 3 and 14, those skilled in the art should recognize that a second etch chemistry must be used to form the via in the inorganic dielectric layer silicon dioxide in the process of Jain. The second etch chemistry to form the via in the inorganic dielectric silicon dioxide layer must be different to the first etch chemistry to form the trench in the low dielectric constant layer of parylene since the second etch

chemistry is performed on etching silicon dioxide while the first etch chemistry is performed on etching paralene.

2. Claims 1-5, 10-14 and 24, as being best understood, are rejected under 35 U.S.C. 102(e) as being anticipated by Smith [US 6,277,733].

Notice : *this rejection is based on the scope of using "a low dielectric constant layer" as a name of a dielectric layer to define a trench.*

Smith , figs 1-2's and col 1-5, discloses a method for making a multi-layer inter-metal dielectric over a substrate or a dielectric structure for dual-damascene application comprising steps of:

forming a barrier layer (422, a silicon nitride, fig 2a) on a substrate and metallization lines (420) within the substrate;

forming an inorganic dielectric silicon dioxide layer (424, FSG or silicon dioxide by TEOS, fig 2a , col 3 lines 25-27) to define a via dielectric layer over the barrier layer;

forming a low dielectric constant layer (430, e.g. fluorinated parylene, fig 2c) to define a trench dielectric layer over the inorganic dielectric silicon dioxide layer; and

forming a trench through the low dielectric constant layer by a first etch chemistry, forming a via in the trench extending through inorganic dielectric silicon dioxide layer to the barrier layer by a second etch chemistry, and etching the barrier layer (see col 3 lines 63-67 and col 4 lines 1-7); and

forming a via and trench barrier layer (434, fig 2g) to cover a surface within the via and the trench wherein the via and trench barrier layer is one of tantalum nitride material and tantalum material.

With respect to claim 3 and 14, those skilled in the art should recognize that Jain discloses the second etch chemistry being different than the first etch chemistry because the first etch chemistry is performed on etching fluorinated parylene and the second etch chemistry is performed on etching silicon dioxide. The first etch chemistry when etching fluorinated parylene must be different to the second etch chemistry when etching silicon dioxide.

3. Claims 1-4 and 10-16, as being best understood, are rejected under 35 U.S.C. 102(e) as being anticipated by Wang et al [US 6,255,735].

\*\*Notice: *this rejection is based on the scope of using "a low dielectric constant layer" as a name of a dielectric layer to define a trench.*

Wang et al, figs 1-11 and col 1-8, discloses a method for making a multi-layer iner-metal dielectric over a substrate or a dielectric structure for dual-damascene application comprising steps of:

forming a barrier layer (12, silicon nitride , fig 1) on a substrate and metallization lines within the substrate;

forming an inorganic dielectric silicon dioxide layer (14, silicon dioxide or SiO<sub>2</sub>, fig 2, col 5 lines 40-41) to define a via dielectric layer over the barrier layer, said inorganic dielectric silicon dioxide can be selectively etched to the barrier;

forming a low dielectric constant layer (18, e.g. BCB, fig 3, col 5 lines 51-67 and col 6 lines 1-11) to define a trench dielectric layer over the inorganic dielectric silicon dioxide layer;



forming a trench through the low dielectric constant layer by implementing a first etch chemistry;

forming a via in the trench extending through the inorganic dielectric silicon dioxide layer through the low dielectric layer by implementing a second etch chemistry which is selective to the barrier layer wherein the second etch chemistry is different than the first etch chemistry.

[see figs 8-9, col 6 lines 35-63].

4. Claims 1-4 and 10-16, as being best understood, are rejected under 35 U.S.C. 102(e) as being anticipated by Wang et al [US 6,207,577].

**\*\*Notice:** *this rejection is based on the scope of using "a low dielectric constant layer" as a name of a dielectric layer to define a trench.*

Wang et al, figs 2-13 and col 1-7, discloses a method for making a multi-layer inter-metal dielectric over a substrate or a dielectric structure for dual-damascene application comprising steps of:

forming a barrier layer (22, silicon nitride, fig 1) on a substrate and metalization lines within the substrate;

forming an inorganic dielectric silicon dioxide layer (24, silicon dioxide or SiO<sub>2</sub>, fig 3) to define a via dielectric layer over the barrier layer;

forming a low dielectric constant layer (30, e.g. BCB, fig 7) to define a trench dielectric layer over the inorganic dielectric silicon dioxide layer;

forming a trench through the low dielectric constant layer by implementing a first etch chemistry (see fig 10); and

forming a via in the trench extending through the inorganic dielectric silicon dioxide layer through the low dielectric layer by implementing a second etch chemistry which is selective to the barrier layer (see fig 11) wherein the second etch chemistry is different than the first etch chemistry.

***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 4-9, 15-16 and 24, as being best understood, are rejected under 35 U.S.C. 103(a) as being unpatentable over Jain [US 5,821,168], Smith [US 6,277,733], Wang et al [US 6,255,735] or Wang et al [US 6,207,577], as applied to claims 1 or 10 above, in further view of Usami [US 6,077,574].

With respect to claim 4 and 11, Jain teaches forming the barrier layer of a nitride but does not expressly teach the barrier layer is one of silicon nitride or silicon carbide. However, silicon nitride and silicon carbide are well-known barrier materials in forming a dual damascene structure or a multiplayer inter-metal dielectric over a substrate. The selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co., Inc. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945) (Claims to a printing ink comprising a solvent having the vapor pressure characteristics of butyl carbitol so that the ink would

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not dry at room temperature but would dry quickly upon heating were held invalid over a reference teaching a printing ink made with a different solvent that was nonvolatile at room temperature but highly volatile when heated in view of an article which taught the desired boiling point and vapor pressure characteristics of a solvent for printing inks and a catalog teaching the boiling point and vapor pressure characteristics of butyl carbitol. "Reading a list and selecting a known compound to meet known requirements is no more ingenious than selecting the last piece to put in the last opening in a jig - saw puzzle." 65 USPQ at 301.).

With respect to claims 5, 7, 8 and 12, Examiner takes an Official Notice that using TEOS for depositing an inorganic dielectric of undoped silicon dioxide is well-known in the art.

With respect to claims 6-7, 13, Jain, Smith, Wang ('577) and Wang ('735) do not expressly teach forming the low dielectric constant layer including depositing a carbon-doped oxide layer. Usami teach depositing a carbon-doped oxide layer for forming a low dielectric constant layer with a good resistance to moisture and resistance to heat. It would have been obvious for those skilled in the art to combine the teaching of Usami to the process of either Jain, Smith, Wang ('577) or Wang ('735) to deposit the carbon-doped oxide layer as the low dielectric constant layer for defining the trench for interconnection in a device with low RC, good resistance to moisture and resistance to heat.

With respect to claim 24, Examiner takes an Official Notice that forming a via and trench barrier layer of Ta or TaN to cover a surface within the via and the trench is well-

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known in the art to improve a device operation such as preventing interdiffusion or peeling problems in interconnection of a dual damascene structure in a semiconductor device.

### ***Response to Arguments***

6. Applicant's arguments filed 4/23/02 have been fully considered but they are not persuasive.

❖ Contradict to Applicant's argument on pages 5-6, claims 1-16 and 24 are indefinite for failing to particularly point out and distinctly claim the subject matter which the Applicants regard as the invention as below:

- "the inorganic dielectric layer being highly selective relative to the barrier layer when etched" renders claim 1 to indefinite. It is not clear what will be etched when "when etched" – when the inorganic dielectric layer is etched? or when the barrier layer is etched? or when the metallization is etched? Or when a low dielectric constant layer is etched? The scope of the claim, therefore, is not clearly defined to be protected. In addition, "highly selective relative to" is a relative term which renders the claim indefinite – how "highly" is considered as highly selective? Applicants argue that a selectivity of 20:1 is excellent while a selectivity of 5:1 is poor. This is not persuasive since the value of selectivity is not claimed. What happen if the selectivity of 2:1 to the others who are not Applicants is considered as high when selectivity of 1:1 is considered as low? Moreover, "the inorganic dielectric layer being highly

selective relative to the barrier when etched" is a "not- positively-cited" limitation that does not have patent weight since a step etching is not positively cited – What happened if a step of etching is not existed in the process for making a dielectric structure for a dual-damascene application? The etch selectivity will not be necessarily considered (carrying patent weight) when an etch step to the inorganic dielectric layer or an etch step to the barrier layer is not performed. Therefore, "the inorganic dielectric layer being highly selective relative to the barrier when etched" will not have patent weight unless a step of etching, to a specific layer, is positively cited in the claim.

- "a low dielectric constant layer" is a relative term which renders the claimed indefinite. It is not clear how low is considered as a low dielectric constant layer. The scope of the claims can not be clear to be protected unless the claim defines the dielectric constant value of "a low dielectric constant layer". What happens if a layer is considered as a low dielectric constant layer when the value of dielectric constant of the layer of about 3.5 under the view of someone who is not Applicants? Applicants argue that a low dielectric constant layer is a layer having a dielectric constant of 3.0 or lower.

However, this is not what is claimed.

- ❖ Contradict to Applicants' argument on page 8, claims 1-3, 7-8, 10, and 14 are anticipated by Jain [US 5,821,168]. Jain teaches a low dielectric constant layer (54,

paralene, fig 3) over an inorganic dielectric layer silicon dioxide layer (26, silicon dioxide by TEOS) [see col 3 lines 14-24 for details]

- ❖ Contradict to Applicants' argument on pages 9-10, claims 1-5, 10-14 and 24 are anticipated by Smith [US 6,277,733]. Smith teaches a trench layer of a low dielectric constant layer (430, fluorinated parylene, col 3 lines 56-62) over a via layer of inorganic dielectric silicon dioxide layer (424, silicon dioxide by TEOS, col 3 lines 25-27)
- ❖ Contradict to Applicants' argument on page 10, claims 1-4 and 10-16 are anticipated by Wang [US 6,255,735]. Wang teaches a trench layer of a low dielectric constant layer (18, BCB) over a via layer of inorganic dielectric silicon dioxide layer (14, silicon dioxide or SiOF).
- ❖ Contradict to Applicants' argument on page 10-11, claims 1-4 and 10-16 are anticipated by Wang [US 6,207,577]. Wang teaches a trench layer of a low dielectric constant layer (30, BCB, fig 7) over a via layer of inorganic dielectric silicon dioxide layer (24, silicon dioxide, fig 3).

### ***Conclusion***

7. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not

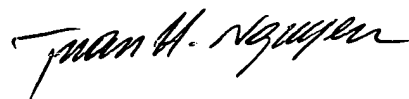
mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanhha Pham whose telephone number is (703) 308-6172. The examiner can normally be reached on Monday-Thursday 8:00 AM - 7:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Chaudhuri Olik can be reached on (703) 306-2794. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-3432 for regular communications and (703) 308-7725 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Thanhha Pham  
July 13, 2002



Tuan H. Nguyen  
Primary Examiner